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CHALLENGING MINDS, CHANGING LIVES

Commentary

Utility of Vaccinations and the Body's Immune System[a]

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Vaccinations are biological substances used to stimulate the body's immune system to develop immunity against certain pathogens. Vaccines are the most common methods used to prevent the widespread infection of diseases. Today, there are several vaccines used to prevent and control the spread of diseases such as the human papillomavirus (HPV) vaccine, influenza (flu) vaccine, and the chicken pox vaccination. The use of vaccines has been acknowledged as the reason for the eradication of smallpox and the reduction of certain diseases such as measles, tetanus and polio. In the late 1700s, it was Edward Jenner who discovered the small pox vaccination, as many other scientists, such as the French chemist and microbiologist Louis Pasteur struggled to find a cure for small pox.

The necessity of vaccines occurs when a foreign substance comes in contact with the immune system to initiate some type of immune response. The main types currently used in clinical practice are (a) inactivated vaccine, (b) attenuated vaccine, (c) virus-like particles vaccines, and (d) subunit vaccines. An inactivated vaccine occurs when viruses or bacteria are developed in culture and killed by a form of heat. Then the virus or bacteria particles are damaged and cannot reproduce. At this point, the bacteria can be recognized and remembered by the immune system and would be capable of initiating an immune response when necessary. Attenuated vaccines are produced by decreasing the extreme harmful effects of a pathogen. Virus-like particles are not true viruses, they only look like viruses. Virus-like particles are not infectious because of their lack of viral genetic material. Common virus-like particle vaccines used in clinical practice are the Hepatitis B virus vaccination and the human papillomavirus vaccine. These virus particles are more immunogenic than others because of their high capability to replicate. Subunits vaccines transpire when antigens come into contact with the immune system without presenting viral particles. So, to reduce the risk of epidemics and plagues of diseases, agencies across the world have implemented policies to require vaccinations in the developing world.

Public health is usually enacted through public policies, necessitating that the public engage in debates that, ideally, are grounded in solid scientific findings. Mistrust in science, however, has compromised the possibility of deriving sound policy from such debates, partially owing to justified concerns regarding undue interference and even outright manipulation by commercial interests. This situation has generated problematic impasses, one of which is the emergence of an anti-vaccination movement that is already affecting public health, with a resurgence in the United States of preventable diseases thought to have been eradicated (Camargo

& Grant, 2015). Vaccines are considered one of the greatest public health achievements of the 20th century for their role in eradicating smallpox and controlling polio, measles, rubella, and other infectious diseases in the United States. Despite their effectiveness in preventing and eradicating disease, routine childhood vaccine utilization remains suboptimal. Parent refusal of vaccines has contributed to outbreaks of vaccine preventable diseases, such as measles and pertussis (Maglione, 2014).

Throughout the history of administering vaccinations, there have been certain individuals who were against the use of vaccines, known as anti-vaccinationists. Anti-vaccinationists believed that the use of vaccines was useless and only an act of the government interfering with personal affairs, and they felt vaccinations were not safe. Some researchers believe that there is a link between vaccinations and autism, while others suggest that there is no association between autism spectrum disorders and vaccinations. This belief has sparked such a controversy in the United States that many parents are deciding not to vaccinate their children. A worldwide increase in the rate of autism diagnoses—likely driven by broadened diagnostic criteria and increased awareness—has fueled concerns that an environmental exposure like vaccines might cause autism. Theories for this putative association have centered on the measles-mumps-rubella (MMR) vaccine, thimerosal, and the large number of vaccines currently administered. However, both epidemiological and biological studies fail to support these claims (Plotkin, Gerber, & Offit, 2009).

Taylor, Swerdfeger, and Eslick (2014) conducted a meta-analysis to summarize available evidence from case-control and cohort studies on the topic of vaccines and autism spectrum disorders. Eligible studies assessed the relationship between vaccine administration and the subsequent development of autism or autism spectrum disorders (ASD). Five cohort studies involving 1,256,407 children, and five case-control studies involving 9,920 children were included in this analysis. The cohort data revealed no relationship between vaccination and autism, and no relationship between autism and measles, mumps, rubella (MMR), thimerosal, or mercury (Hg). Similarly the case-control data found no evidence of increased risk of developing autism or ASD following MMR, Hg, or thimerosal exposure when grouped by condition or grouped by exposure. Findings of this meta-analysis suggest that vaccinations are not associated with the development of autism or autism spectrum disorder. Furthermore, the components of the vaccines (thimerosal or mercury) or multiple vaccines (MMR) are not associated with the development of autism or autism spectrum disorder.

The Expanded Programme on Immunisation (EPI) has been one of the most successful global childhood programmes, reducing mortality and morbidity from vaccine-preventable diseases and providing opportunities for other interventions. EPI vaccination visits (usually at birth, 6weeks, 10weeks, 14 weeks, and 9 months of age) are crucial contact points between a child and the health system, where vaccines and other essential health care interventions like Long-Lasting Insecticidal Nets (LLINs), de-worming, vitamin A, and growth assessments are given (Scott et al., 2014). Improvement of public health by immunization through vaccinations has been a consistent policy in the United States for decades. In the late 1950s and early 1960s, the federal government established a nationwide vaccination policy based upon the Vaccination Assistance Act. Accordingly, by the late 1960s, several states established mandatory vaccination policies for children upon school entry against an array of infectious diseases, and, by the late 1970s, all 50 states had adopted this vaccine mandate. Currently, all states require vaccinations against measles, polio, rubella, and diphtheria while vaccinations against other major contagious diseases are either required or recommended (Song, Silva, & Jenkins-Smith, 2015).

Common vaccinations required are hepatitis B (hepB) vaccinations, diphtheria, tetanus and pertussis (DTAP), polio, haemophilus influenza type B vaccine (Hib), pneumococcal, MMR, meningococcal meningitis, and chicken pox (varicella). Each year, about 8.8 million children under the age of five die due to neonatal complications, diarrhea, and pneumonia, under nutrition, measles and malaria. About 35% of deaths of children under five-years old and 11% of the total global disease burden can be attributed to undernutrition. Today, more than 195 million children in developing countries are stunted. Inadequate infant and child feeding practices and micronutrient deficiencies are major contributors to under nutrition, stunting, and morbidity and mortality in children and indirectly to immune status and vaccine response (Qadri, Bhuiyan, Sack, & Svennerholm 2013). Vaccines may bring economic benefits beyond just health gains and there may be various pathways for these benefits to accrue. Unlike other health interventions, studies find that vaccines avert illness both directly through immunization and indirectly through herd immunity. Both types of prevention can lead to a healthier, more productive population that can contribute more toward a country's economic development. For example, by averting illness directly, households with vaccinated children can save medical costs and parents may take fewer days off of work to care for sick children. By averting disabilities, some vaccines may prevent delays in cognitive development and may also improve school enrollment and attainment. By averting deaths, vaccines may even alter fertility decisions due to greater child survival (Ozawa, 2012).

The last decade saw significant advances in developing, introducing and expanding the reach of vaccines globally. More people than ever before were vaccinated, resulting in significant achievements, including the near eradication of polio and significant reductions in deaths caused by vaccine-preventable diseases (diphtheria, measles, neonatal tetanus, pertussis). Around 2 million deaths among children under 5 years of age are prevented annually despite an increase in birth cohorts every year. Further, increasingly sophisticated vaccines, including pneumococcal conjugate vaccine,rotavirus, and human papillomavirus (HPV) vaccines, were rolled out globally. The vaccine industry based in the developed world (as represented by the International Federation of Pharmaceutical Manufacturers Association) and developing countries (represented by the Developing Countries Vaccine Manufacturers Network, DCVMN) plays a significant role in the achievement of global immunization targets (Jadhav, Gautam, & Gairola, 2014).

In many countries, after the introduction of mass immunization campaigns, the prevalence of hepatitis B virus (HBV) notably changed, resulting in a decrease of the HBsAg carrier rate and hepatocellular carcinoma (HCC) incidence. It was estimated that liver cancer represents approximately 4% of all new cancer cases diagnosed worldwide and that more than 50% of liver cancers were attributable to HBV. The highest age adjusted incidence rate (>20 per 100,000) was reported from Southeast Asian and Sub Saharan African countries that are endemic for HBV infection. Up to 90% of infants infected during the first year of life and 30%-50% of children infected between one to four years of age develop chronic infections, and about 25% of adults who become chronically infected during childhood die from HBV-related liver cancer or cirrhosis. HBV continues to be the major HCC risk factor worldwide, although its importance will continue to decrease during the next decades due to the widespread use of the HBV vaccine in newborns (Franco et al., 2012).

A critical factor shaping parental attitudes to vaccination is the parents' interactions with health professionals. An effective interaction can address the concerns of vaccine supportive parents and motivate a hesitant parent towards vaccine acceptance. Conversely, poor communication can contribute to rejection of vaccinations or dissatisfaction with care. Such poor communication often results from a belief by the health professional that vaccine refusal arises from ignorance which can simply be addressed by persuading or

providing more information. Such an approach is counter-productive because it fails to account for the complexity of reasons underpinning vaccine refusal and may even result in a backfire effect. Parental vaccination decisions are based on an array of factors and parents integrate information according to their experiential and social contexts. A parent's trust in the source of information may be more important than what is in the information (Leask, 2012).

The significance of the use of vaccinations in children continues to be a controversial issue. There are many reasons why parents may chose or decline to have their children vaccinated. The benefits of having children vaccinated may be for the safety of the general public. Vaccinations decrease the risk of diseases spreading among children in various places such as schools, hospitals, and daycare centers. These are common facilities that children most frequently visit. Because children are around other children, the risk of spreading diseases due to the lack of vaccination is substantially high. Diseases are more likely to spread in crowded areas, and the use of vaccinations is a common and effective method known to eradicate some diseases. The health and safety of our children and the general public is a public health concern.

The cost of treating diseases will rise as the incidence of diseases increase, causing an economic burden on the health care system. Some people support vaccinations, while others are totally against them. For those who refuse to protect themselves from harmful diseases by declining vaccinations, their actions may be viewed as being unfair to others. Individuals who oppose vaccinations feel that the government should not enforce mandatory immunizations. These people believe in freedom of choice when it comes to deciding on vaccinations for their children. However, for some others, the downfall of receiving vaccinations is more related to personal beliefs. Some people may perceive that vaccinations cause mental impairments and other childhood conditions.

While some developing countries currently have children less than five years of age dying from polio, measles, pneumonia, malaria and other known childhood diseases due to the lack of access to health care, poverty and the lack of clean water that carry parasites, the state of Mississippi has become a leader in vaccinating its children. Mississippi does not allow certain exemptions, like other states, such as religious purposes and/or personal or philosophical reasons. The state of Mississippi only consents to medical exceptions where persons may be immunosuppressant or under age.

Conclusion

Since the era of the 1700s, vaccinations have been proven to eradicate disease. Vaccines may save lives and prevent the spread of diseases. Refusing vaccinations in childhood may increase the child's risk of developing disease and spreading the disease to others. As a result, outbreaks of disease may occur. While some people believe that vaccinations cause autism and other diseases, for others, it is their belief and personal right that parents should not be commanded to vaccinate their children. Even though, vaccines have proven to be effective in keeping children healthy and saving lives, in many developing countries, the incidence and prevalence of disease continue to exist due to the lack of access to vaccinations. Ultimately, it is critical that consensus is reached regarding the utility of vaccinations because it is important that all citizens of this nation live in an environment that is safe and healthy.

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